INTERFACING ELECTRONIC FOR MEASUREMENT, SIGNAL PROCESSING AND WIRELESS COMMUNICATION

Edited by

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Chapter 12

CONVETERS RESULTS VERIFICATIONS

MA LI YA, SHEROZ KHAN, ANIS NURASHIKIN

Once the converters (ADCs or DACs) have been developed, we need to verify and test the circuit function as well as the properties. In this chapter, different techniques to analyze the results from the converters are introduced.

12.1. INTRODUCTION

Analog-to-digital converters and digital-to-analog converters are essential building blocks in modern electronic systems. They form the critical link between the input of conversion system and the output. The wide variety of digital signal processing (DSP) applications leads to the availability of a wide variety of converters of varying price, performance, and quality. For an ideal ADCs, the difference between the analog input voltage and the corresponding voltage of the nearest code center is the quantization error, as shown in Eq. (1) (Lundberg, 2002).

$$V_{IN} = V_{FS} \sum_{k=0}^{N-1} \frac{b_k}{2^{k+1}} + \varepsilon \tag{1}$$

Where, V_{FS} is the full scale voltage, b_k are the individual output bits, and ε is the quantization error. In the reality, since the existing of static imperfections (such as gain, offset, mismatching), parasitic capacitance, etc. the real converters are different from the ideal behavior. Therefore, the converters' testing and verifications become an essential stage in the end of any converter's design. For ADCs and DACs, they have their own different ways to verify the performance and properties of the designed system. In this chapter, several methods to test the converter systems are introduced.

12.2. ADC TESTING

For testing a designed ADC, at the schematic level, generally there are three ways; i) To calculate the digital output bits and compare it with the analog value. This method is fit for stair case or even ramp ADC. The small resolution (or conversion bit) can be calculated, but not reasonable for the high resolution conversion or oversampling conversions; ii) To convert the ADC output back to an analog signal using an ideal DAC and compare with each other in time domain. An ideal DAC is usually designed by using "vcvs" (voltage controlled voltage source) which is a two port network. The main problem of this method is that it needs to design another high resolution digital-to-analog converter. By the way, the final analog output will inherit the quantization error from DAC; and iii)